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THE IMPLICATIONS OF VIDEO DATALINK ON THE AC-130

A thesis presented to the Faculty of the US Army Command and General Staff College in partial fulfillment of he requirements for the degree

MASTER OF MILITARY ART AND SCIENCE

by

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ABSTRACT

THE IMPLICATIONS OF VIDEO DATALINK ON THE AC-130 by Maj J. Marcus Hicks, USAF, 83 pages.

This study considers the implications of video datalink (VDL) on the AC-130. Gunships use infrared and low-light television sensors, and synthetic aperture radar to search for and to identify targets for close air support and interdiction missions. The addition of VDL offers gunship crews the ability to employ real-time information to the cockpit/offboard targeting (RTIC/OT) technology to improve situational awareness, survivability, and operational flexibility. Also, VDL offers the joint forces air component commander (JFACC) inflight tasking capability, increased reconnaissance capability, operational flexibility and situational awareness. Ultimately, VDL allows command and control elements to exercise direct control of gunship operations.

These capabilities are beneficial when they provide information to the crew or to the JFACC. However, VDL used to provide direct control of gunship operations may violate the Air Force doctrinal tenet of centralized control and decentralized execution. Lessons learned from recent contingencies, leadership doctrine, academic works on leadership and management theory all suggest that direct control of tactical missions can cause decreased survivability, ineffective span of control, task saturation, tactical inflexibility, mistrust between commanders and subordinates, decreased morale, and subordinates that lack initiative.

The study provides recommendations to mitigate potential problems associated with the use of VDL on gunships.

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CHAPTER 1

INTRODUCTION

Background and Context

The advent of advanced technologies, such as satellite communications (SATCOM) and global positioning system (GPS), offer tremendous capabilities that have given the US military a clear advantage in operations during the last decade. Satellite communications have improved long-haul communications by offering reliable, secure communications beyond line-of-sight. Similarly, GPS has made navigation dramatically more accurate, reliable, and less labor intensive. The dramatic success of these technologies in contingency operations from the Persian Gulf to Bosnia has set the standard for communications and navigational accuracy. As the standard for communications and navigation has increased, so, too, has the demand for developing and integrating new technologies to increase existing capabilities and to develop new capabilities.

While both SATCOM and GPS represent quantum leaps in the fields of communication and navigation, they are essentially evolutionary advances in an already existing capability. Satellite communications is, operationally, a more capable radio system. Similarly, GPS is a better tool for navigation. Still, the synergistic effect of the integration of these capabilities has supported an evolutionary step in military operations. The synergistic relationship between improved communications provided by the proliferation of SATCOM and the navigational accuracy of GPS has changed the nature of

not only communications and navigation, but of command and control, intelligence collection and dissemination, and battle damage assessment.

Now technology offers the capability to transmit video imagery to or from almost anywhere on the globe. For the purpose of this paper the term video datalink (VDL) will include any system that transmits digital-video imagery via radio-frequency datalink. Video datalink includes single-frame transmissions that take several minutes to transfer, in near-real time, as well as full video transmitted immediately, in real time. Similarly, both line-of-sight transmissions and beyond-line-of-sight transmissions, using SATCOM capability, are part of the generic term, VDL. Finally, VDL includes all levels of quality of transmission. Any degradation of image quality, as a function of systems employed, is addressed as a separate issue.

Unlike SATCOM and GPS, VDL does not represent an evolutionary technology. The military has never before had a widely disseminated capability to communicate efficiently via video imagery. Transmission of video has been the realm of television news organizations and teleconferencing, using relatively bulky and expensive equipment. Now tactically exploitable VDL is being fielded by the Air Force and Navy to send and to receive video between aircraft and ground stations. This capability is not just a better type of communications system but a whole new type of communications system. Video datalink can provide aircrews imagery of targets while inflight and offers the potential for commanders, at virtually any level, to see images directly from the field. While there are successful examples of VDL transmissions from reconnaissance platforms, such as the

Predator unmanned aerial vehicle (UAV), the full implications of VDL are not fully understood.[1]

Research Question

In particular, the implications of VDL on weapon systems that rely on video imagery for normal operations are not fully understood. For example, the AC-130 gunship relies heavily on video imagery for target acquisition, identification, and engagement. For this reason, gunships may be particularly suited for the integration of VDL into normal operations. However, the implications of VDL on gunship operations, and particularly command and control, are not yet known. Therefore, this paper identifies the implications of VDL on operations, and particularly command and control, of the AC-130 gunship.

In order to understand the implications of VDL on gunship operations, it is necessary to understand something of gunship operations. The AC-130 is a side-firing gunship that uses electro-optical and electronic sensors to search for, to identify, and to engage targets. The electro-optical sensors are a low-light-level television and an imaging-infrared sensor, or infrared detection set (IDS). The electronic sensor on the AC-130H is a beacon-tracking radar while the AC-130U has an imaging, synthetic-aperture radar (SAR) derived from the F-15E. The electro-optical sensors are optimized for night operations but are also very capable in daylight. Night operations are preferred in order to use darkness to mitigate the threat from visually-aimed weapons. The radars provide limited all-weather capability. Each electro-optical sensor is operated by a dedicated sensor operator in the interior of the aircraft, while the SAR is operated by the navigator.

The two sensor operators are controlled by the fire control officer who also inputs sensor and weapon combinations and makes adjustments to ballistic solutions based on aircraft position and observed misses from previous shots. The navigator provides navigation and communicates with surface forces, in the case of close air support missions. Additionally, a dedicated electronic warfare operator provides electronic warning and defense for the crew while also operating the beacon tracking radar in the AC-130H, and the SATCOM radio on either aircraft. The sensors are integrated into a sophisticated fire-control system that delivers superb accuracy with the 105mm and 40mm cannons in the aft, left of the aircraft, and the twin 20mm cannons in the front, left of the AC-130H and the single 25mm cannon in the left, front of the AC-130U. The 105mm, 40mm, and the 25mm are on hydraulic mounts that are controlled by the fire control computer. The guns are loaded and maintained by gunners that also act as scanners for threats to the aircraft.

In order to find a desired target, the crew studies imagery of the desired target during mission planning. If imagery is not available, map study must suffice. Normally, the crew develops a plan to identify a selected target using recognizable features such as nearby road intersections. The crew enters target coordinates into the mission computer which incorporates a filtered navigation solution for superb navigational accuracy. The mission computer provides navigational direction to the pilots in order to establish an orbit around the target area. Even before the aircraft arrives over a target, the sensor operators, under the direction of the FCO, search for the target and planned identification points. Once the sensor operators, FCO, and navigator are satisfied that a target is identified, the FCO enters a primary sensor and gun combination to engage the target. The primary

sensor operator will hold the target in the center of his video screen to establish a target reference for the fire-control computer. The computer provides both a target symbol, or primary aimline (PA), and a computed impact point (CIP) in the aircraft commander's heads-up-display. The PA provides a reference for the target while the CIP is the pilot's reference for aiming the guns. The pilot maneuvers the aircraft to aim the gun at the target by moving the CIP to coincide with the PA. Using the hydraulic, trainable gunmounts, the pilot need only move the CIP to within a few degrees of the PA. The gunmounts, controlled by the fire-control computer, slave to superimpose the CIP over the PA. Theoretically, when the CIP and PA are superimposed, the gun can fire and hit the target, represented by the PA. Normally, the crew must make minor adjustments after the first shots in order to ensure accuracy.

There are two significance points of this operation. First, targeting is entirely sensor based. Normally, most fighter crews, in daylight operations, visually acquire and identify a target and then superimpose a computer-generated CIP over the target for the attack. In contrast, the AC-130 crew virtually always uses video data from electro-optical and electronic sensors to acquire and identify the target. The CIP is superimposed over a computer generated target reference, the PA, rather than the visually acquired target. Therefore, the gunship could be considered a video-data based weapon system. Notably, many fighter aircraft now employ electro-optical sensors for many operations, but few to the extent that is routine to gunship crews. Based on the reliance on video data, the gunship is a prime candidate for a study of the implications of the integration of VDL.

The second important point is that the gunship is a very crew-coordination intensive aircraft. On one hand, the number of crewmembers (thirteen to fifteen) gives the gunship the capability to perform multiple, simultaneous tasks. On the other hand, the aircraft commander is challenged with a difficult leadership task. While all crewmembers are highly trained in their individual tasks, the aircraft commander must ensure that each member functions as part of a team. Any loss of situational awareness on the part of a crewmember could introduce delays in providing critical support to surface forces. Additionally, confusion can cause delays that increase the threat to the gunship by extending time in a threat environment. Therefore, maintaining good crew coordination is vital to the accomplishment of the gunship mission and the survival of the crew.

Operational Definitions

Another consideration about the AC-130 is that gunships are an Air Force Special Operations Command (AFSOC) asset. In a given contingency, gunships may be under operational control of the special operations forces air component commander, normally called the Joint Special Operations Air Component Commander (JSOACC). However, gunships may also be under the operational control of the conventional forces air component commander, either a Combined or Joint Forces Air Component Commander (CFACC or JFACC). Due to the unique capabilities and limitations of the AC-130, the preferred arrangement is for gunships to fall under the operational control of the JSOACC. The implications of the specific command and control arrangement are not germane to the research question. Therefore, for the purpose of this paper the generic term "air component commander" (ACC) will be used to represent any commander with either

operational control or tactical control of the AC-130. Additionally, while the ACC will have at least tactical control over the gunship mission, any member of the AOC staff that is authorized to make decisions vis-à-vis tactical operations will be covered by the ACC; i.e., the internal command control relationships of the AOC are beyond the scope of this paper.

Similarly, the air operations center (AOC), the headquarters for the ACC, can exist as a joint or combined AOC, or as a special-operations variant. For the purpose of this paper, an AOC is any headquarters and staff organization used by the ACC to command and control airpower assets.

Additionally, the terms that describe levels of command and control must also be addressed in order to explore the implications of VDL on the AC-130. The master tenet of Air Force basic doctrine is "centralized control and decentralized execution."[2] The definition of both centralized control and decentralized execution are open to some interpretation as described in *Air Force Basic Doctrine*. Specifically, centralized control is described as a result of lessons from World War II through Vietnam where "command of US airpower was fragmented and controlled by competing commanders."[3] Centralized control was intended to allow commanders to "give coherence, guidance, and organization to the air and space effort and maintain the ability to focus the tremendous impact of air and space power wherever needed across the theater of operations."[4] Therefore, for the purpose of this paper, any command and control arrangement that allows commanders to give guidance and focus to the airpower effort can be considered centralized control.

More specifically, if airpower missions are tasked from a single headquarters, or AOC, the command and control arrangement can be considered centrally controlled.

A specific definition for decentralized execution is more illusive. *Air Force Basic Doctrine* describes decentralized execution as the "delegation of execution authority to responsible and capable lower-level commanders." Delegating execution authority is further described as "essential to achieve effective span of control and to foster initiative, situational responsiveness, and tactical flexibility."[5] The difficulty in defining decentralized execution is in identifying the appropriate level of "lower-level commander" to whom execution authority is delegated. Interpretations of the appropriate level of decentralization will ultimately be influenced by the political visibility of the contingency, the intensity of the operation, the command and control technology available, and the individual personality and capability of the commander. Therefore, this work will not attempt to develop a definition of decentralized execution that applies to all situations. On the contrary, the lack of specific guidance as to which lower-level commander should retain execution authority suggests that this level may change as conditions dictate. Additionally, the second tenent of airpower, "flexibility and versatility," further suggests that situations may dictate the specific level of decentralization.[6] Furthermore, the exact definition of "execution authority" is not clear. Here, too, the definition seems to be open to some interpretation, based on the situation and personality of the commander. However, a working understanding of decentralized execution is necessary to frame many of the implications of VDL on the command and control of gunships.

Therefore, for the purpose of this paper, any command and control arrangement that maintains execution authority at a central location, such as the AOC, can be considered centralized execution. Further, "execution authority" should be interpreted as the authority to make tactical decisions that are normally the purview of the aircraft commander, including the decision to release weapons, or clearance to fire, based on published rules of engagement. Additionally, any arrangement that violates an "effective span of control," either by limitations in information or by information overload can be considered centralized execution. Similarly, any arrangement that fails to "foster initiative, situational responsiveness, and tactical flexibility" can be considered centralized execution.

Another consideration is that many works discussing command and control capabilities and limitations use the broad term "control" to include many levels of control, including levels that would be considered centralized execution. Therefore, terms such as "direct control" or "close control" should be considered synonymous with what the Air Force would term centralized execution.

A final term to consider is the high-visibility mission. For the most part, the idea that some missions involve more political pressure than others is intuitive. These missions normally take place as part of a small operation, such as the invasion of a small country. However, the level of political and military pressure will vary depending on an almost infinite number of variables. Therefore, a universally acceptable definition of high visibility may be difficult to develop. For the purpose of this work, a high visibility mission could include any mission where the success or failure would be an international news story.

Limitations

There was very little published information specifically discussing both the potential benefits of VDL technology and potential drawbacks. On the contrary, works that discussed the potential capabilities of emergent technologies seem to dismiss any potential penalties associated with new capabilities. Therefore, it was necessary identify a variety of potential benefits associated with VDL technology. Then, potential drawbacks were correlated with these potential benefits, based on existing precedence.

Delimitations

This project is delimited to a case study of the implications of VDL on command and control of the AC-130 gunship. The choice of the AC-130 was based on the authors experience as an AC-130H/U pilot and the particular nature of gunship operations. Specifically, by using video imagery from onboard sensors, gunships seem to be more compatible with VDL technology than more visually-based weapon systems. In order to determine how command and control would be affected by the installation of VDL, some basic capabilities of video transmission were developed. In order to remain focused on the capabilities offered by VDL vis-à-vis command and control, it was necessary to develop general capabilities.

Additionally, only published works supporting general capabilities that tie into the command and control relationship were used. Interviews with individuals in the gunship community may identify potential uses for VDL in specific situations, but specific scenarios are not necessary to develop the relationship between capabilities and current command and control concepts. Moreover, specific scenarios suggest a limited impact of

additional capabilities. The effort of this paper is to develop broad relationships and identify general rules, rather than exceptions. Similarly, interviews with senior-level commanders with tactical control of gunship operations may reveal some common understanding of how VDL may impact the command and control relationship. However, this paper is attempting to identify potential implications based on current doctrine, rather than identify any body of thought about how VDL may be exploited by individual personalities. Published doctrine along with published interpretations of appropriate command and control relationships gives a more general view of the implications of emergent technology on command and control.

Within the literature available, there are several published works that suggest more decentralization of airpower assets is appropriate. Conversely, there is also a school of thought that suggests more centralized execution is appropriate. In order to avoid taking sides in the ongoing academic debate about the appropriate level of centralization, this work only references the previously discussed interpretations of published doctrine.

Finally, because this work is primarily a discussion of the implications of technology, rather than of technology itself, there is very little discussion about specific systems. Nominal systems, their capabilities and potential complications, are used for the purpose of illustration. Any research and discussion about system capabilities is only for an understanding of what types of capabilities and limitations one might expect to see in the near term. Chapter five includes some basic discussion about the implications of the type of system installed.

Significance

Primarily, this work may be significant to the AC-130 community, including customers, such as tasking organizations and surface forces supported by close air support. Potentially, system acquisition , integration, doctrinal development and training could be influenced by this work and follow-on efforts. The limited scope avoids specific implications to other precision strike aircraft, like the F-15E, the F-117A, and the F/A-18. This specific delimitation is due to the scope of this work, not just the unique nature of gunship operations. Therefore, it is possible, and perhaps even probable, that certain basic concepts developed in this paper will apply equally well to other weapon systems. Finally, this work may influence the interpretation of centralized control and decentralized execution. Specifically, this paper may serve as a point of departure for additional study into the broader implications of centralized execution.

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[1] Kenneth Munson, ed., *Jane's Unmanned Aerial Vehicles and Targets* (Southampton, UK, Hobbs, 1995) issue 0.

[2] Air Force Doctrine Document 1, *Air Force Basic Doctrine*, September 1987, 23.

[3] Ibid.

[4] Ibid.

[5] Ibid.

[6] Ibid.

CHAPTER 2

REVIEW OF LITERATURE

The initial review of literature was conducted in three general areas. First published military doctrine was reviewed to attempt to identify applicable definitions, terms, concepts, and considerations regarding command and control, particularly vis-à-vis communications technologies. Next a number of professional papers and masters theses were consulted to see if anyone had addressed anything close to the topic. Also, studies, after action reviews, and lessons learned from recent conflicts were reviewed for any considerations about command and control and new technologies. Third, academic works on the art of command and leadership were reviewed to see if there is any consensus, or body of thought, about the leadership considerations associated with advanced communications capability.

Doctrine

Air Force Doctrine Document 1, *Air Force Basic Doctrine*, was the primary doctrinal reference as it describes the seven tenets of aerospace power. The first of these, the master tenet, centralized control and decentralized execution is central to the research question. That is, how might the incorporation of video-datalink (VDL) on the AC-130 effect centralized control and give the air commander maximum flexibility or otherwise change current capability? Also, to what extent is decentralized execution required to ensure effective spans of control, responsiveness, and tactical flexibility? Is there a clear doctrinal definition of centralized control and how does centralized control and

decentralized execution balanced for optimum effectiveness? Where does centralized control end and decentralized execution begin?

These tenets of aerospace power can be considered the foundation for the employment of airpower. The master tenet is consistently reinforced by the subsequent five tenets. Also, the balance of control versus tactical flexibility remains a clear theme.[1] Additional research was directed to identify specific instances where this balance is critical and where and when control should be emphasized over tactical flexibility, or decentralized execution. The inclusion of the potential influence of VDL in the AC-130 appears to be a valid case study.

Air Force Manual 1-1, Volume II, contains expanded discussions of the tenets of aerospace power.[2] Although AFM 1-1 was superseded by AFDD 1, these essays were used to further illustrate and clarify the tenets. Although these doctrinal tenets are considered the foundation of aerospace power employment, they will not be considered inviolate or sacrosanct. Additional research may find that situations not only change the emphasis between centralized control and decentralized execution, but may support violating a tenet entirely.

Additional doctrinal review included joint publications to see if there was any further expansion or limitation of the tenets of aerospace power. Also, investigating US Army and US Marine Corps doctrinal works on command and control helped develop concepts of how positive control relates to centralized control and decentralized execution. Specifically, US Army FM 100-5, *Operations*, was an excellent source for a definition and discussion on the commander's intent. The commander's intent relates to

the topic in that it facilitates initiative in subordinates. The Marine Corps MCDP 6, *Command and Control*, also developed the concept of commander's intent and was also a wealth of information on leadership. This reference discussed the differences in leadership theories and styles. Also, the Marine Corps has done an excellent job of describing some of the implications of initiative and the logic behind the desire to decentralize decisionmaking as much as possible.

Academic Works

The next main area of review looked at academic works in the area of command and control or command and control technologies. Most of the available works covering command and control discussed large issues such as who should command joint-aerospace forces. Also, most works on command and control systems discuss computerized management systems that produce air tasking orders or communications technologies that could coordinate future battlefields and feed commanders more information. The need for sound communication and intelligence collection capability was a primary theme. The noted requirements included secure communications, especially satellite communications (SATCOM), and the need for near-real-time imagery for target identification and battle damage assessment. There may be potential for the AC-130, equipped with VDL, to both provide and use near-real-time or real-time imagery. Therefore, works on reconnaissance technologies helped develop a framework for understanding some intended uses of video imagery. However, one should consider the gunship mission. While the need for improved reconnaissance appears in some of the literature, gunships are not specifically tasked as reconnaissance platforms. While VDL could make the AC-130 a

more capable reconnaissance platform, the implications of "mission creep" also need to be discussed. Therefore, the implications of mission creep were also investigated in lessons learned and in more conceptual works.

In "Rethinking the Air Operations Center: Air Force Command and Control in Conventional War," Lieutenant Colonel J. Taylor Sink argues for mission-type orders to increase tactical flexibility. He notes that onboard mission planning systems would be necessary to achieve maximum flexibility for either alert or diverted missions. He specifically mentions the need "to transmit real-time or near-real-time intelligence to the cockpit for threat location and avoidance." This type of data transfer could also help in flexible targeting. Lt Col Sink also recommends increased decentralization of execution decisions and notes that it is potentially controversial since this could be seen as moving away from the doctrine of centralized control. This assertion highlights an emergent debate within the airpower community. Although centralized control and decentralized execution remains the Air Force's master tenent (AFDD 1 is less than a year old at this writing), there is some debate as to whether or not centralized control is the optimal relationship for command and control of airpower assets. One supporting argument for increased decentralization is to allow for failed or degraded communications. This concept will be investigated because continued reliance on current communications technologies may reduce our capability to operate with degraded systems in the future. A critical issue in this work is the following.

> Limited decentralization is probably most appropriate for conventional war, since many efforts are being conducted simultaneously and some mistakes can be tolerated. Decentralization is not appropriate for raids and demonstrations of force, where a specific political result is vital and mistakes not tolerable. Also, limited

> decentralization will require training subordinates how to make operational targeting decisions.[3]

This passage supports some critical issues. First, there are differences in command and control requirements between different types of operations. Clearly, higher visibility missions may require more centralized control. Centralized control may limit tactical flexibility, but political realities may take priority over tactical concerns. Second, decentralized control requires training to the capability. The inference here is that considerable training time must be spent on developing the judgement and decision of tactical commanders. Continued research was directed toward the implications of various types of missions and the relative need for centralized control.

Another look at command and control restructuring was the Airpower Research Institute report "Tailoring the Tactical Air Control System for Contingencies," by Lieutenant Colonel Robert J. Blunden, Jr. The report notes that during politically sensitive missions there may be increased emphasis on up channel monitoring.[4] This concept supports both the idea that there are different information-flow requirements during different types of conflict and that VDL could be particularly valuable to the AC-130 community which is typically involved in high visibility operations.

"Command and Control in Low Intensity Conflict: Adequacy of Current Military Arrangements and Joint Doctrine," an Air Command and Staff College paper, identifies conflicting concepts for command and control. One view supports centralized control of tactical operations throughout an operation while another argues for delegation to the lowest possible level. The later proponent includes the concern that higher echelons do

not interfere with lower echelons.[5] Both of these conflicting opinions will be fully investigated with respect to AC-130 employment. The valid difference in opinion about the level of centralized control is at the heart of implications for VDL integration on the AC-130. Therefore, further research was necessary to clarify those circumstances which support each divergent opinion.

An initial source for views about the balance between centralized command and decentralized execution is the Air War College Research Report "Command and Control and Communications Lessons Learned: Iranian Rescue, Falklands Conflict, Grenada Invasion, Libya Raid," by Colonel Stephen E. Anno and Lieutenant Colonel William E. Einspahr. They cite this balance through out their report. The need to keep higher echelons informed was consistent between each operation called for sophisticated communications capability. Satellite communications and secure voice figured prominently in their review of each operation and as a whole. This observation supports the installation of VDL on gunships as a means to keep higher echelons informed. Of particular note was the finding that "In small, politically sensitive operations, like Grenada, extensive up-channel reporting is thus seen as another key to success." Again, the concept that all combat is not alike with respect to command-and-control and communications was apparent. Political sensitivity is clearly a factor that should be considered when deciding how much centralized control is appropriate. Additional research was needed to correlate political sensitivity and high visibility with any increased risk to forces or the mission caused by centralized control. A common theme between each mission was the need to

delegate maximum authority to the lowest possible level. This value of delegating authority seemed self evident to the authors of the report.

Along with this basic concept the report highlighted the need for commanders to issue mission-type orders and allow subordinates to decide how to accomplish the mission. Realizing the natural conflict between the need for up-channel reporting and non interference by higher echelon commanders the report stated "the balance must be for tactical operational decisions to be the purview of the on-scene commander." Again this concept seems to be self evident. Further research into the lessons learned and leadership theory helped reveal specific reasons for the inherent value of decentralized authority. Specific considerations about leadership and authority may help determine how VDL on gunships can be optimized without allowing or causing over-centralized control. Some evidence of why commanders should not get involved with subordinate's decisions came from the Iranian hostage rescue attempt.

> [The report stated:] it is incumbent upon the authorities at these distant locations not to insert themselves into the tactical decision process. The on-sight commanders require autonomy. Definitive guidance and decision criteria must be clearly established before an operation is underway. Beyond that, authorities must rely on their ability to select the right man for the job; one who is also capable of initiative and the competence to make the right decision.

This statement does not specifically explain why interference is inappropriate, but it does make two important points. First, the onus is clearly on the senior commander not to interfere, and second, subordinate commanders must be trusted. The later can only be achieved by training that habitually emphasizes this relationship. Therefore, one could argue that centralized control of tactical operations must be the rare exception, rather than

the rule. Another important issue about data flow was the idea of information overload. Even during the Falklands Conflict information saturation was cited as a problem. This potential exists on the aircraft as VDL offers another information source which could overload the crew or an individual, thereby causing reduced efficiency, which could place the crew and mission at risk. Similarly, and more in line with the lessons learned, increased information to a command and control facility could overload a commander or his staff. Finally, availability and commonality of equipment was poor in each operation and is considered crucial for future operations where there is likely to be limited time available to develop of acquire systems.[6]

Additional evidence about the benefits of decentralized tactical execution was available in Colonel Robert W. Peterman's "Mission Type Orders: An Employment Concept for the Future." Col Peterman cites several sources for why too much centralized control causes problems.[7] These sources were reviewed for specific relevance. Examples such as President Johnson determining targets in Vietnam are potentially supportive of a requirement for tactical flexibility. However, examples that discuss command relationships between political leaders and senior commanders may not directly apply to the relationship between command elements and an AC-130 crew. Further, trends caused by excessively centralized control during long, conventional wars may not apply to politically sensitive, high visibility missions.

A good source of specific evidence of the disadvantages of overcentralization was the Airpower Research Institute report "The Tactical Air Control System: its Evolution and its Need for Battle Managers," by Major Thomas H. Buchanan. This report

specifically talks to the disadvantages of overcentralization and the tendency for commanders to micromanage subordinate commanders, particularly with the advent of sophisticated communications capability. The potential for commanders to become more involved with tactical actions is a specific concern associated with the installation of VDL on the AC-130. The report also argues that we need to train for decentralized control in order to endure the fog and friction of war. Major Buchanan cites several sources that support training with mission type orders and allowing maximum decentralization.[8] These sources were also investigated for relevance to the research topic since many advocates of mission-type orders are discussing ground combat. The concepts of land warfare do not necessarily apply to the employment of airpower and, therefore, may not be particularly relevant to the topic.

Another major consideration of communication technologies was discussed in the Air Command and Staff College Research Report "Joint Air Operations Center: C4I Structure Study" which emphasized a need for interoperability and commonality of emerging technologies.[9] The need for interoperability may be self evident, but must also be addressed as a consideration for acquiring and fielding emerging technologies. Specific technological issues are beyond the scope of this study. However, basic systems capabilities may determine potential implications to command and control. Therefore, basic capabilities and their potential impact were examined with respect to their relevance to the AC-130.

A number of implications of technology on command and control were illustrated in *the Command or control dilemma: when Technology and Organizational Orientation*

collide, an Air War College paper by Lieutenant Colonel Gregory A. Roman. In his paper, Lt Col Roman addressed the tendency for more centralization to decrease initiative in subordinates. Also, he discussed the concept that the price of more certainty at higher echelons is more uncertainty at lower echelons. Further, Lt Col Roman addressed the relationship between hierarchical and network structures. Hierarchical structures, he argues, tend to stifle initiative and, therefore, senior leadership must be careful not to interfere with the tactical authority of subordinates.[10] These concepts relate to the installation of VDL on gunships due to the increased communications capability and responsiveness.

The Nerves of War: Emerging Issues in and References to Command and Control, by Dr. Roger A. Beaumont, gave additional insight to the relationship between emergent technology and command and control. Dr. Beaumont discussed the potential for dependence on technology to erode ability to function with out it. Also, the capability for commanders to increasingly control the actions of subordinates was noted as a threat to moral and combat effectiveness. Finally, Dr. Beaumont noted the requirement to properly train to use and become comfortable with both command and control technology and procedures.[11]

For an alternate view of the value of centralized control, Joseph F. Bouchard's *Command in Crisis* researched four case studies where there was a disconnect between high-level political goals and tactical-level decisions. The book discusses some of the problems with attempting to make political statements with military force and the tendency for the tactical commanders to make on-scene decisions that negatively effect the overall

political mission. Bouchard argues that senior commanders should centrally direct tactical operations in order to avoid unintended political statements. His conclusions, however, seem to support the concept of decentralized decision making associated with a clear commander's intent because he identifies the disconnect between tactical requirements and overall political aims. These disconnects may be caused by a lack of mutual understanding between the tactical commander and the political leadership, but it is not clear that more direct control is necessary to avoid such disconnects.[12]

There is essentially a subcategory of information regarding command and control technology related to the research topic. That is a group of test reports, test plans, and reviews of exercises using real-time and near-real-time data transfer from and to combat aircraft. The first of these was a Naval Air Warfare Center paper entitled *Rapid Targeting and Real Time response: the Critical Links for Effective Use of Combined Intelligence Products in Combat Operations*. This paper was very helpful as an overview and synopsis of several Air Force and Navy initiatives to exploit national intelligence capabilities by sending target data aircraft. The paper defined the term real-time information into the cockpit/offboard targeting (RTIC/OT) which is essentially the concept of video datalink associated with reconnaissance. Therefore, examples of RTIC/OT demonstrations could be used directly to identify most of the capability implications associated with VDL installation on the AC-130. The paper described the operational concept of employing RTIC/OT to assign targets to airborne aircraft, a specific implication for VDL on gunships, and discussed some of the technical challenges associated with current

technology. Again, specific technological issues are beyond the scope of this paper, but basic concepts associated with real-time data transfer capability were helpful.[13]

Another particularly helpful work was the demonstration test plan for Project Strike II. This plan described the plan to integrate RTIC into Air Force F-15E strike aircraft.[14] Since there are certain parallels between the F-15E and the AC-130H/U, both in capability and employment concept, it was possible to draw certain comparisons between the implications of video-data transfer to the F-15E and the AC-130H/U.

A third source for data on the capabilities of RTIC and strike aircraft was the summary of the classified test GOLD PAN 95-2. This demonstration test further developed the capability to datalink video to strike aircraft. The classified portion discussed actual response times and was not critical to this report since the research question seeks to identify implications of VDL on gunships rather than specific responsiveness.[15]

Interestingly, a review of the Army's Task Force XXI Advanced Warfighter Experiment published in the *Strategic Forum* gave additional support for technical capabilities of advanced communications. Additionally, the article echoed the concern that increased communications technology could adversely affect the commander subordinate relationship. The article by Lieutenant Colonel Mark Hanna noted the following with regard to situational awareness provided by sophisticated technology.

> Perfect awareness could make it possible for a higher commander to centralize decisions, crushing subordinate leader initiative with micro-management. There is also a danger that commanders and leaders at all levels could grow too dependent on "perfect" information and hesitate to seize initiative in the absence to a complete picture.[16]

This article helps to develop the nature of the concern for the implications of emergent technology on command and control of modern weapon systems.

Leadership and Command

The next category of literature reviewed was academic work on leadership and the art of command. Works on basic leadership theory were reviewed to develop a common reference and basis for departure. Similarly, works on military command, including doctrinal publications were investigated in order to identify major trends in military leadership theory. This area was particularly important because the concept of decentralized authority versus centralized command and control was becoming central to the research question. In another words the Air Force doctrinal tenent of centralized control and decentralized execution appears to include the gray area between centralized command and decentralized command. Therefore, it was important to establish some common reference for what constituted over-centralized control. The appropriate balance between centralized authority or command and decentralized authority or execution appears to be open to quite a bit of interpretation and, more importantly, is rather situational dependent. This gray area inherent in centralized control and decentralized execution required additional research into the situational nature of centralization of authority.

A good book on leadership and organization by Robert Guest, Paul Hersey and Kenneth Blanchard entitled *Organizational Change through Effective Leadership* provided a good starting point and frame of reference for basic leadership theory.

This work provided an excellent explanation of Situational Leadership Theory. This theory describes four levels of follower maturity from low to high. Associated with each level were appropriate leadership styles and explanations for why each particular style was appropriate.[17]

The Marine Corps Doctrinal Publication 6 (MCDP 6), on *Command and Control*, tied Situational Leadership Theory to military command. This work offered a military interpretation and explanation of Situational Leadership Theory. Terms associated with management style were associated with military terms, thereby setting a basis for exactly why delegating authority to the lowest possible level was important in a military environment. Examples and explanations in MCDP 6 described how appropriate delegation of authority was important to develop, over a period of time, confidence and trust between commanders and subordinates. Additionally, the work clearly established and justified the criticality of initiative, which is understood as important throughout military communities. Establishing the importance of initiative was necessary to the research question because the concept appears to be self evident to military writers. Therefore, it is beneficial to develop a common understanding of exactly why initiative is important, particularly vis-à-vis the commander's increasing capability to directly control tactical operations.[18]

The US Army operations manual was cited to reinforce the universality of initiative and develop a common reference for how commanders facilitate initiative in subordinates. The definition of commander's intent provided the link between a requirement for

initiative in subordinates and the need to give clear guidance for what must be done, rather than how it must be accomplished.[19]

Next, the noted historian Martin Van Creveld's *Command in War* provided a variety of insights into military command and decisionmaking. Van Creveld discussed the search for information and certainty in battle and the trade off between certainty at the top and certainty at lower levels. Here again, there was support for the need to decentralize decisionmaking. Additionally, Van Creveld presented the temptation for commanders to look to the rear rather than to the front as an effect of advances in communications technologies. The book included several examples of senior commanders' struggles with this temptation and established the requirement for a commander to use restraint in directing subordinates that have a better sense of the tactical situation.[20]

Carl Von Clausewitz' immortal work *On War* was reviewed in order to identify some basic and lasting concepts of war and command. The concepts of "fog" and "friction" originate in this work and are necessary to understand the continuing dilemma commanders and subordinates have faced throughout the history of warfare.[21] Additional review attempted to identify any immutable principles of leadership and command. Similarly, *The Art of War*, by Sun Tzu was reviewed to glean any bits of wisdom on the constant principles of war and command.

There seems to be ample evidence to adequately identify and develop the implications of video datalink on command and control of the AC-130 gunship. The US Air Force doctrine of centralized control and decentralized execution establishes a basis for departure into command and control relationships. Additional doctrinal concepts

about command relationships further develop this point. A number of works identified capabilities and concepts to exploit communication technology that can be extrapolated to gunship operations. These works showed a potential to increased flexibility and situational awareness of both the gunship crew and the command element. Other works showed that as communications capability, such as video datalink, increases the capability of commanders to directly control forces also increases. Historical references to this concept consistently show how detrimental over centralization has been to military operations. Therefore, the nature of the relationship between commanders and subordinates was developed to further identify a specific implication of VDL capability on gunships. The human element of command and control in an increasingly technological age became the most controversial implication of video datalink. Consequently, training became an important factor for the optimal use of additional technology. Finally, there were several identifiable factors that could influence the commander to subordinate relationship, but specific command and control arrangements may continue to depend on specific situations and individual commanders.

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[2] Air Force Manual 1-1, Volume 2, *Basic Aerospace Doctrine of the United States Air Force*, March 1992, 113-125.

[3] Lt Col J. Taylor Sink, *Rethinking the Air Operations Center: Air Force Command and Control in Conventional War* (Maxwell AFB, AL: Air University Press, September 1994), 41-41.

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[9] Maj David Wessner and others, "Joint Air Operations Center: C4I Structure Study" (Thesis, Air Command and Staff College, Maxwell AFB, AL, April 1995), 32, 57.

[10] Lt Col Gregory A. Roman, *The Command or Control Dilemma: When Technology and Organizational orientation Collide* (Maxwell AFB, AL: Air University Press, February 1997) 158-174.

[11] Dr. Roger A. Beaumont, *The Nerves of War: Emerging Issues in and References to Command and Control* (Washington DC: AFCEA International Press, 1986), 54-56.

[12] Joseph F. Bouchard, *Command in Crisis: Four Case Studies* (New York: Columbia University Press, 1991), 188-189.

[13] Danny Searle, et. al., *Rapid Targeting and Real Time Response: The Critical Links for Effective Use of Combined Intelligence Products in Combat Operations* (Naval Air Warfare Center Weapons Division, China Lake, CA, Dec 1996), 2-3.

[14] Maj James W. Hibbard, *Project Strike II* (Air Warfare Center, Nellis AFB, NV, Oct 1996).

[15] Brian Young, et. al., *Gold Pan 95-2 Demonstration Exercise* (Aeronautical Systems Center, Wright-Patterson AFB, OH, Dec 1996)1-2.

[16] LTC Mark Hanna, "Task Force XXI: The Army's Digital Experiment," *Strategic Forum* 119 (July 1997): 4.

[17] Robert H. Guest, Paul Hersey, and Kenneth H. Blanchard, *Organizational Change through Effective Leadership* (New Jersey: Prentice-Hall, 1977), 18-22.

[18] Marine Corps Doctrinal Publication 6 (MCDP 6), *Command and Control*, 4 October 1996, 649-138.

[19] Field Manual (FM) 100-5, *Operations*, June 1993, 6-6.

[20] Martin Van Creveld, *Command in War* (Massachusetts: Harvard University Press, 1985), 108, 258, 270.

[21]Carl Von Clausewitz, *On War*, trans. and ed. by Michael Howard and Peter Paret, (Princeton, NJ: Princeton University Press, 1989)

CHAPTER 3

REASEARCH METHODOLOGY

The research for the implications of video datalink (VDL) on the command and control of the AC-130 Gunship was conducted in four broad phases. First, doctrinal references for command and control of air-power assets, and specifically the AC-130, were reviewed. This review developed a baseline for current doctrine with respect to how and when an air component commander (ACC) normally directs aircraft or flight commanders. Any broad concepts should relate directly to gunship operations. Both joint and Air Force doctrine were reviewed both for general and specific references for command-and-control procedures. General references can be concepts that apply to a number of situations and may indirectly influence gunship operations. The tenent of centralized control and decentralized execution is an example of a general reference. Any procedure that identifies command relationships, or how the AC-130 or similar weapon system was to be employed, would be specific guidance.

Given a baseline of current doctrine and procedures, the second phase was designed to identify any historical references for command-and-control implications with either VDL or some similar technology. Historical examples were reviewed to identify any lessons germane to the VDL on the AC-130 situation. Here the challenge was to set criteria to establish validity of historical examples. The initial test was that technology, or a specific situation, needed to affect the normal command-and-control relationship between a force, or weapon system, and the command element. Examples where technology or a certain information flow procedure increased the commander's situational

awareness without giving him the capability to influence the situation were normally not pertinent to the case study.

This examination also showed how much latitude and flexibility was available, for both commanders and crews, within the published doctrine. Additionally, any conflicting interpretations of standing doctrine or particular points of controversy helped in determining how command and control can be an additive or detractor from the tactical employment of the AC-130. Lessons learned, or not learned, from contingency operations tend to show how well command and control worked and identified where and when more or less information would have been beneficial.

Along with identifying how well information transfer worked in the past, historical references showed evidence of where additional types of information could have been beneficial. Since this case study concentrates on the implications of video-data-link, any historical references to instances where video image transfer, either as a single frame or as a video clip, could have been helpful were identified. For the sake of balance, periods where video transfer could have been detrimental to the mission were also identified. In both cases, there is some level of conjecture about how beneficial or detrimental VDL would have been. The basic criteria for an instance where VDL would have been beneficial was a period when either a crew or the command-and-control element needed to see a particular picture to assist in decision making. An obvious example is when a crew needed a picture of a new target. This image may have originated from another source, such as a satellite image, or from another gunship if one aircraft was relieving another for fuel or oxygen limitations. For the command-and-control element, any time an image was

needed for immediate intelligence considerations would probably constitute a benefit of VDL. However, passing an image to the command-and-control element for additional target identification for clearance to fire is problematic. In some cases, such as an extremely high-visibility mission, where there was little or no threat to the crew, this additional evaluation may be beneficial. In that case, trained interpreters would be required to interpret the image. In cases where there was a significant threat to the crew, any delay for additional interpretation could be dangerous and, therefore, probably not justifiable. The primary drawback to additional interpretation of gunship video is that having a command-and-control element "second guess" a trained crew is, at best, in the gray area between centralized control and decentralized execution. The next phase was specifically designed to examine the implications of over centralized control.

The third research phase investigated historical examples of command leadership, with particular emphasis on how much centralized control was appropriate. This broad topic transcends the spectrum of conflict and type of force employed. Examples of centralized and decentralized control of ground forces and mixed ground and air forces were also addressed. Particular attention was paid not to inappropriately extrapolate lessons for air forces from to those of surface forces. However, some examples showed a clear relationship to AC-130 operations. In those cases, the leadership-to-subordinate relationship was the critical issue. Trust between the command-and-control element and the operators was identified as a critical element, not just for the immediate operation, but for developing and maintaining a climate where initiative was not stifled.

The fourth phase was designed to address the leadership implications of centralized control and decentralized execution. As the research progressed it became apparent that the technological issues were not nearly as important as the human factors of leadership and trust. Some academic works on leadership were reviewed to identify current concepts of leadership vis-à-vis centralized control. Here particular attention was paid to ensure that conceptual leadership ideas were cogent to gunship operations. Also, to be integrated into the overall concept of using VDL for combat operations, leadership ideas were tempered with military necessity. That is to say, the use of lethal force when national prestige is at stake can be considered a case where pure necessity overrides good leadership principles. However, these cases must be justifiable and understood by all participants. The cost of overcentralization must be acceptable in each situation.

These research phases ran concurrently for the first several months of this project. As more information was gathered it became apparent that the initial concerns about technical criteria, such as data-transfer rate and transfer quality, were subordinate to the human element of command and control. Therefore, technical issues were addressed as potential concerns, rather than as an effort to identify specific systems requirements. However, some basic issues, such as the need for uninterrupted voice communications and reasonably fast transfer rates, were noted where appropriate.

The method of analysis was to study published doctrine and procedure, lessons learned from historical examples, and then both historical and academic leadership issues. These areas of study yielded a collection of implications to be analyzed in chapter five. Again, the human factors were seen as paramount. Evidence was collected, organized as

to relevance and impact, and specific cases and scenarios were built to analyze and to evaluate the conclusions of this paper. Where personal experience showed a particular inclination, evidence to the contrary was specifically researched and included where appropriate. The final conclusions show that the implications of VDL on the command and control of the AC-130 are dependant on the specific situation. However, when possible, generalizations were made in an attempt to offer those involved in gunship operations some basic ideas on how to best use this emergent technology.

CHAPTER 4

ANALYSIS

> Science and history are opposing factors in the problem of the future means and methods of war. Anyone who seeks to solve the problem thoughtfully, instead of sensationally, soon feels their contradictory pull upon his mind. In a dual sense it is a tug of war.
>
> B. H. Liddell Hart[1]

The analysis of the implications of video datalink (VDL) is divided into two major sections. First, this chapter develops the capability implications of the installation of VDL on the AC-130. These capabilities are discussed from the perspective of the crew, identifying the potential implications as both benefits and limitations. Then, potential capabilities of VDL are developed from the perspective of the command and control authority, ultimately resulting in an increased capability to remotely control gunship operations. The second portion of this chapter looks at a variety of implications of this increased capability to directly control gunship operations which, as discussed in chapter one, may be considered centralized execution. Also as discussed in chapter one, the air component commander (ACC) should be considered a generic commander with at least tactical control of gunship operations. Similarly, the air operations center (AOC) could be a joint, combined, special operations variant, or any organization designated to exercise command and control of gunship operations.

The organization of this chapter is designed to sequentially lead from some basic capabilities to more amorphous considerations. In many cases there is overlap and apparent redundancy between some capabilities and implications. This overlap is partially

a result of an effort to specifically identify the implications of VDL on a variety of discrete tasks performed in gunship operations and partially due to the interrelation of various factors discussed below. This discussion is not exhaustive, but should be considered a basis from which to develop additional capabilities and doctrinal parameters for the use of VDL on the AC-130 gunship.

Implications for the Crew

Situational Awareness

The ability to transmit and receive video imagery on the AC-130 gunship offers several potential capabilities to the gunship crew. First, the ability to receive updated imagery of a target area could improve the crews' situational awareness. Under optimal conditions, mission planning includes extensive study of current imagery and the development of a specific plan for identifying an assigned target using identifiable reference points, such as road intersections or uniquely shaped buildings. When imagery is not available map study must suffice. Once the gunship arrives on station, sensor imagery of a target and other identifiable features is compared to the imagery used to plan the mission. Changes in weather or surface conditions could cause the sensor imagery to seem different from the imagery used for mission planning. For example, cloud cover over a road intersection could change the appearance of the target environment. Similarly, damage to a building occurring after images were made may confuse the identification process. Updated imagery of the target environment, sent to the aircraft while enroute to a target, could allow the crew to anticipate any changes in the appearance of the target environment. Anticipating changes will help the crew maintain situational awareness and

efficiently conduct a given mission. With this concept in mind, the Air Force and Navy are developing systems and procedures to transmit "theater-level multisource intelligence data (e.g. U-2, JSTARS, RJ, UAVs) to improve accuracy, [and] improve situational awareness."[2]

Updated intelligence and imagery will be more critical in a rapidly changing environment. The Naval Air Warfare Center Weapons Division noted the following.

> Precision attack of fixed and rapidly relocatable targets with brief attack windows (e.g., Scud missile launchers in Iraq, camouflaged tanks and artillery in Bosnia, and antiship surface to surface cruise missile (SSCM) launchers in the case of amphibious missions) is one of the primary areas in which improved capabilities are needed. National and theater intelligence assets, especially imagery-capable systems, must now detect and localize the target and threats for aircraft in a more timely manner to address the dynamic battlefield.[3]

This paper specifically deals with the implications of video-data transfer and does not include the transfer of other threat information. Therefore, the potential benefits of transmitting other threat data is beyond the scope of this paper.

Survivability

A collateral benefit of improving situational awareness is an inherent improvement in aircraft and crew survivability. Target identification is accomplished by matching sensor imagery with the imagery used for mission planning. Ideally, the target appearance on the sensor imagery will be exactly as on the mission planning imagery. Any changes in the appearance of the target could add significant delays to the target identification process. Delays may increase risk to the crew by extending their exposure to threat systems. Delays may also reduce the element of surprise as the gunship orbits around the target attempting to make a positive identification. The Air Force Tactical Exploitation of

National Capabilities Talon Shooter (AFTENCAP/TS) program is developing automated information update capabilities to deliver a variety of enhanced intelligence to and from aircraft. The AFTENCAP/ST program showed potential benefits to aircraft survivability by the transmission of threat updates, navigation information, and weather changes to airborne aircraft.[4] As previously noted, the implications of non-video data of threat systems is beyond the scope of this paper. However, the potential increase to survivability obtained by increased targeting efficiency is worth noting. As "limit exposure" is one of the bedrock survivability concepts to gunship employment, any program or system that supports rapid target acquisition, identification, and engagement can be considered to enhance survivability.[5]

Close Air Support

Given that close air support (CAS) is the primary mission of the gunship,[6] there is an interesting potential for ground controllers to send targeting information to the gunship in the form of video imagery. Currently, the standard CAS control procedures involve voice description of the target, along with coordinates, and, preferably, an offset from a known location, either a beacon or some optically recognizable point.[7] The author is aware of some initiatives to use a video camera, possibly integrated with a GPS receiver, compass, and range finder, to send imagery from the ground perspective directly to the gunship. This concept has not been officially tested, but may be useful in some circumstances. A potential drawback is that imagery taken from the ground will appear different from the overhead view. However, imagery, even from a dramatically different perspective, may be more easily interpreted than a voice description.

Rehearsal/Inflight Targeting

The ability to receive video data could allow crews to develop and rehearse attacks even as they approach the employment area. The capability to update an attack plan continuously and rehearse the plan could increase the gunship crew's ability to adapt to a rapidly changing situation. With offboard imagery collectors, either satellite, unmanned aerial vehicle (UAV), other aircraft, or surface observers, the gunship crew could observe the target and prepare to react to a changing situation. Effects of unforeseen weather or light conditions that complicate target identification could be mitigated by the combination of VDL and reconnaissance platforms observing a selected target. By receiving video imagery similar to the gunship sensor imagery, data-linked imagery could allow the crew to "virtually arrive" at a target long before the aircraft and crew entered a threat environment. "Virtual presence," or "offboard targeting" could allow the crew to seamlessly transition from offboard imagery to onboard imagery and attack a target with minimum delay and exposure to hostile fire. Complex target identification and verification could be done in the minutes before arriving at the target rather than while orbiting a target, reducing the element of surprise, and increasing risk to the crew by increasing exposure to a hostile environment. Both the Air Force and the Navy have demonstrated the potential for in-flight targeting with near-real-time or real-time information into the cockpit.

> [The Goldpan and Forward Hunter programs]are examples of real-time Information into the cockpit/offboard targeting (RTIC/OT) demonstrations. These programs have shown the value of providing real-time mission updates (based on national offboard signals and imagery intelligence) to shooters pursuing time-critical targets. All these programs employed national exploitation systems and source material products to show that RTIC/OT can increase mission

> effectiveness, enhance survivability, and increase operational flexibility against time-critical fixed and mobile targets.[8]

The ability for crews to use RTIC/OT to conduct inflight mission planning and rehearsals not only enhances current operations, but gives the crew a new capability that could be exploited by a command and control agency. Therefore, the next section will address the implications of video datalink for the air component commander.

Implications For The Command Authority

Inflight Tasking

The corollary to the crews capability to conduct inflight mission planning using the VDL portion of RTIC/OT is the ability for the air component commander (ACC) to efficiently task or redirect aircraft in flight. Given that video data transfer could allow the crew to conduct offboard targeting, there is little conceptual difference between a significant target update and a change to an entirely different target. If a reconnaissance platform can downlink imagery of a target, and the crew is capable of inflight mission planning, the ACC should be able to task a gunship to conduct a mission while inflight. The AC-130 is an excellent candidate for inflight tasking since the fire control officer, navigator, and sensor operators can dedicate themselves to receiving and assimilating downlinked information and creating an attack plan while the pilots and electronic warfare officer concentrate on enroute operations. The task divisions on the gunship are unique to the strike-aircraft community and, therefore, could be exploited by the ACC to give him maximum flexibility to task limited assets. The gunship's relatively slow speed further

supports retargeting efforts because, even in a small area of operations, there is usually time to develop an attack plan before arriving over the target.

The Air Force's Project Strike I demonstrated the potential for RTIC to allow an ACC to target airborne strike aircraft. Conducted in the summer of 1995, Project Strike I involved B-1B and F-15E strike aircraft to demonstrate the capability of RTIC to conduct precision-attack missions based on targeting information transmitted to the aircraft.[9] Project Strike II was designed primarily to address specific communications architecture requirements and to develop the ability to transfer intelligence from national systems to the strike aircraft. Systems architecture, although critically important, is also beyond the scope of this paper. However, it is worth noting that a specific objective of Project Strike II was to "demonstrate the capability of an AOC to provide target information and imagery directly to an F-15E over SATCOM."[10] The F-15E and AC-130H/U have similar capabilities that are tailored for different threat environments. Both the F-15E and the AC-130U share the use of visual-sensor imagery and synthetic-aperture radar (SAR) as primary targeting devices. Similarly, the F-15E and the AC-130H/U have integrated GPS navigation and SATCOM capability, which allows them to receive information directly from the AOC or other beyond-line-of-sight facilities. Additionally, both aircraft excel at long range, night precision-strike missions. The F-15E is faster, carries heavier ordnance, and, due to speed and maneuverability, is inherently more survivable. The AC-130H/U has better resolution sensors, low-light-television capability, and a precision-strike capability with low-yield ordnance that allows limited collateral damage in comparison to the F-15E. Finally, the AC-130H/U has greater communications capability by virtue of

more radios and additional crewmembers to operate separate frequencies. Therefore, most implications for RTIC applications for the F-15E should be applicable to the AC-130H/U. Project Strike I successfully demonstrated potential benefit of digital-data-linked imagery to enhance situational awareness and inflight tasking.[11]

Airborne Alert

As discussed above, the ability to plan and to rehearse attacks while in the air could allow the ACC to task a gunship inflight. The relatively long loiter time and inflight refueling capability makes the gunship a good asset for airborne alert. In combination with offboard-imagery collectors, VDL could give an ACC, or higher echelons, the ability to respond more quickly to many situations. For example, gunships holding at predesignated tracks could be sent to the scene of a developing situation with real-time imagery that could allow optimal targeting while reducing the need for premission planning. Therefore, the combination of VDL and offboard collectors could give the ACC an airborne alert option without significantly degrading the target identification capability that is a trademark of the AC-130. The same capability could give an ACC intratheater flexibility by allowing him to divert, or retarget, an ongoing mission with the certainty that quality intelligence would be available for the crew.

Intertheater Operations

The ability to assign targets while a gunship is inflight could give the ACC a greater degree of flexibility for force employment. The same capability could give the National Command Authority (NCA) increased options for intertheater operations. In the event of a rapidly developing situation almost anywhere in the world, the AC-130 could be

launched while the political and military options are still under development. Launching a gunship could be analogous to launching nuclear bombers rather than intercontinental-ballistic missiles. That is, a gunship could be launched with the option to return rather than to attack a target. The act of launching a gunship could portend a military response and telegraph national will while preserving precious options for peaceful resolution of a crisis. From a military standpoint, early launch of a gunship could reduce response time to any crisis. Aircraft could take off without extensive planning and thereby decrease response time by combining flight time and mission planning time. Perhaps more dramatically, crews could take off prior to a course of action decision. Once a course of action was chosen, the crews could combine enroute time with mission planning and rehearsal in order to deliver the firepower quickly after a final decision was made.

Reconnaissance

If the AC-130 has the capability to downlink video imagery, that imagery could be transmitted up channel, to the command and control agency, normally the air operations center (AOC). Sending imagery directly to the AOC could allow the ACC to use the gunship's advanced sensors to augment other intelligence capabilities, such as UAVs.[12] Therefore, the AC-130 could be used as a reconnaissance asset. The complimentary array of visual and electronic sensors makes the gunship a capable reconnaissance aircraft. With a gunship in a reconnaissance role, the ACC could task a mission as a reconnaissance flight with the knowledge that he also had precision strike capability. The conflict with using an AC-130 in a reconnaissance role is that gunships are currently tasked for close air support, interdiction, and armed reconnaissance, which is a euphemistic term for search

and destroy.[13] Therefore, adding the reconnaissance mission could be seen as mission creep.

Situational Awareness

The ability to transmit gunship-video imagery to the AOC could also increase the ACC's situational awareness. Currently, gunships record sensor imagery for battle damage assessment (BDA) and hand carry video tapes to the mission debrief where intelligence specialists edit and interpret mission results. This process results in significant delays in relaying battle damage assessments to the AOC. These delays could slow the decision cycle at the AOC. Similarly, delays in getting BDA to the AOC may cause delays in follow-on mission planning or cause AOC planners to operate without full knowledge of the effects of recent missions. In order to reduce these delays, the Air Force conducted demonstrations to show that the AOC could use real-time BDA to increase situational awareness, flexibility, and critical decision making. One of the specific findings of the Strike I program was that sending immediate BDA to the AOC assisted planning at the ACC level.[14]

Along with the potential benefits of real time BDA, up channel monitoring has repeatedly been noted as important. The lessons learned from Operation Eldorado Canyon, the 1983 bombing raid on Libya, showed that it was necessary "to keep higher echelons of command informed."[15] Likewise, the after-action report from Operation Urgent Fury, the 1983 invasion of Grenada, noted the importance of keeping "everyone up the line well informed."[16] It is not clear that keeping higher echelons well informed

required actual video footage of target attacks, but video data could certainly assist in this task.

Increased Control Capability

Up-channel reporting can clearly increase situational awareness at the AOC and other echelons. The extension of this ability to monitor events as they occur is the ability and desire to increasingly control these events.

> [As pointed out after Operation Eldorado Canyon,]up-channel status reporting structure was essential to keep superiors informed. It was also of critical import to provide a structure which could support the ability of the President of other superiors to provide last minute guidance or direction based on any changing political situations.[17]

The requirement for up-channel reporting involves a variety of communications capabilities, such as secure-voice communications and beyond-line-of-sight communications, preferably satellite communications (SATCOM). The value of secure communications, and particularly SATCOM, was a specific lessons learned from the Libya raid.[18] As an addition, VDL transmitted over SATCOM could give higher-echelon commanders the ability to observe a target during a mission anywhere on the globe. While a distant commander could observe a selected target, voice communications could allow that commander to directly control the application of firepower.[19]

Because the targeting process on the AC-130 is video-imagery based, the gunship is particularly suited to offboard monitoring and control. The pilot's vision is rarely the primary means of target identification. All final targeting is accomplished with highly magnified electro-optical sensors operated from the relative detachment of an internal compartment in the aircraft. Therefore, given the capability to transmit real-time video to

higher authorities, the ACC, NCA, or any individuals so designated, could become "virtual crew members." Conceptually, a distant commander could use VDL and voice communications to direct gunship sensors to observe various targets and conduct operations as if that commander was part of the crew. Target selection, identification criteria, engagement criteria, weapons selection, and other tactical decisions could be made remotely. Although control of gunship crews to this extent may be unlikely, technology may soon make it possible.

"Since 1943 the most vexing control issue has been the level at which control should be centralized.... Too much or too little centralization has proven to be counter productive, the former delaying responsiveness and the latter leading to dissipation of effort."[20] The wisdom of maintaining direct control over distant crews will depend on the situation and, ultimately, on the judgement of the command authority. It would be impossible to fully anticipate every combination and permutation of events, both political and military, that could support or refute the correctness of maintaining direct control of tactical missions at higher echelons. Further, due to the subjective nature of the decision as to where control should be maintained, it would be equally impossible to anticipate the variety of personality factors and political and military pressures that will ultimately influence the commander's decisions. Therefore, the specific debate over whether to centralize or decentralize control of airpower assets, and specifically the AC-130, is beyond the scope of this paper. However, the implications of offboard control over gunship operations, or centralized execution, will be addressed in a number of categories.

Command and Control Implications

Doctrinal Considerations

First, the doctrinal concepts associated with command and control establish the basis for command relationships. Both published doctrine and lessons learned from the application of airpower give some insight into the complex nature of command and control. The master tenet of USAF doctrine, spelled out in *Air Force Basic Doctrine*, is "centralized control and decentralized execution." The concept of centralized control of theater air power originates from World War II and has been relearned repeatedly over the last fifty-six years.

> The lesson is clear: attempts to fragment the control and planning of air and space power will ultimately cost blood and treasure by diverting effort and impact. Centralized control allows commanders to focus on those priorities that lead to victory. Through centralized control, commanders give coherence, guidance, and organization to the air and space effort and maintain the ability to focus the tremendous impact of air and space power wherever needed across the theater of operations.[21]

> Based on experience from World War II, Korea, Vietnam, and Operation Desert Storm, the most effective and efficient scheme is control of all aerospace assets by a single joint force air component commander responsible for integrating employment of all aerospace forces within a theater of operations.[22]

As the first part of the master tenet, the doctrine of centralized control is easily understood at the operational level. Theater air power must be under one commander who reports directly to the overall force commander. This arrangement allows the ACC to "exploit the speed and flexibility of aerospace platforms to concentrate forces from diverse locations on decisive points, establish and enforce theater-wide priorities, execute synergistic campaigns, establish appropriate balances, or assure persistent attacks."[23]

> Just as central to the proper application of airpower is the concept of decentralized execution. Delegation of execution authority to responsible and capable lower-level commanders is essential to achieve effective span of control and to foster initiative, situational responsiveness, and tactical flexibility.[24]

However, as discussed in chapter one, a clear understanding of the tenet of decentralized execution is more illusive. Additionally, "modern technologies seem to make decentralization of many important decisions increasingly inappropriate or even unnecessary. The complexities of force packaging require that many decisions concerning targets, routing, force composition, and tactics be made at a relatively high level."[25]

> Still, success in war at the tactical level requires attention to details and the ability to adapt quickly to exploit fleeting opportunities. Although centralized control can effectively concentrate aerospace power within a campaign, commanders exercising such control are likely to be faced with too many units and too little time if they try to master the details necessary to make timely adjustments for tactical effectiveness.

Decentralized execution answers these problems in span of control and survivability. In many cases, beginning with World War II, those exercising centralized control of air forces have defined areas of responsibility, assigned tasks and command of forces, and delegated authority for execution to subordinate air echelons. These subordinate echelons have been responsible for supervising the details and making the rapid adaptations that lead to tactical success.[26]

As noted in chapter one, current Air Force doctrine leaves the area between centralized control and decentralized execution open to some interpretation. It is in this equivocal area that the remainder of this chapter will attempt to identify specific implications of the added capabilities of VDL on the AC-130.

Historical Lessons

Certain operations exist in the equivocal area between centralized control and decentralized execution. In noting the essential nature of up-channel reporting, an after action review of the failed Iranian hostage rescue mission noted the following.

> Communications technologies can provide the means to control an operation thousands of miles away from the action. While such connectivity might be essential for reporting, it is incumbent upon the authorities at these distant locations not to insert themselves into the tactical decision process. The on-site commanders require autonomy. Definitive guidance and decision criteria must be clearly established before an operation is underway. Beyond that, authorities must rely on their ability to select the right man for the job; one who is also capable of initiative and the competence to make the right decisions.[27]

There are several important points in this finding. First, more true today than ever, is that modern communications allow commanders to control operations from virtually any point on the globe. Second, and directly tied to the first, is that it is incumbent upon those commanders not to interfere with the tactical decision process. Third, the commanders must initially establish comprehensive ROE to provide the on-scene commander with appropriate guidelines for sound decision making. The ROE will ultimately set the conditions for successful tactical decisions. The concept of commanders intent, defined in US Army FM 100-5 *Operations*, echoes the need to establish definitive guidance and decision criteria.

> The commander's intent describes the desired end state.... It must clearly state the purpose of the mission. It is the single unifying focus for all subordinate elements. It is not a summary of the concept of the operation. Its purpose is to focus subordinates on the desired end state. Its utility is to focus subordinates on what has to be accomplished in order to achieve success, even when the plan and concept of operations no longer apply, and to discipline their efforts toward that end.[28]

The forth and final point is that commanders must carefully select competent individuals capable of initiative and judgement. This point can hardly be over emphasized. It appears self evident that the time to agonize over the judgement of a tactical commander is before he is assigned a mission. Understandably, flight evaluations of USAF pilots and crewmembers contain a block for judgement.

The Grenada invasion provided similar lessons learned. Both up-channel reporting and a "command structure where it was very, very clear that the field commander was in charge were key elements in the success of the operation."[29] Similarly, the after action report of the Libyan raid echoed the requirement for restraint in commander's input while noting the need for a structure to allow the NCA to "provide last minute guidance or direction based on any changing political situations." The very next sentence stated that "the balance must be for tactical operational decisions to be the purview of the on scene commander."[30]

The most recent example of "defined areas of responsibility" between centralized control and decentralized execution was Operation Deny Flight, the NATO operation to prohibit unauthorized flights over Bosnia and provide close air support for UN Protection Forces on the ground. In this case, weapons release authority was maintained at the AOC level.[31] As discussed in chapter one, retaining release authority at a centralized level can be considered centralized execution because the authority to make tactical decisions, based on published guidance and ROE, is normally the purview of the aircraft commander. However, retaining release authority at the AOC does not specifically limit initiative or tactical flexibility because the ACC is directing an aircraft commander what to do, but not

how it must be done. By granting or denying weapons release authority, a higher-echelon commander does not necessarily limit the on-scene commander's authority to engage the target in the most tactically sound method available. However, if delays in issuing release authority fundamentally violate tactical soundness, maintaining execution authority at the AOC level violates "tactical flexibility" which is a fundamental purpose for decentralized execution. Additional considerations about the implications of maintaining direct control that does not specifically violate "span of control" or "tactical responsiveness" are developed vis-à-vis political military considerations and the more intangible element of leadership.

Political and Military Considerations

Based on the above findings, it seems prudent for the ACC to develop comprehensive ROE and avoid directly controlling gunship missions. However, these missions had their own individual characteristics and context that supported delegating decision making authority to the lowest level. Therefore, it is inappropriate to assume that general lessons from past operations will necessarily dictate specific criteria for future operations. Also, varying interpretations of the appropriate level of direct control as well as future political constraints, as previously noted, may influence commander's decisions. Therefore, it is necessary to identify the factors that have typically influenced the level of direct control of tactical missions.

Political and military factors influencing the appropriate degree of direct command and control involve factors such as the political visibility and the tempo of the operation. Normally, conventional wars include less political visibility of any single mission, where

raids and surgical strikes are often highly political. Also, conventional wars normally operate at very high operations tempos while smaller scale raids may involve a relatively limited effort. In a School of Advanced Airpower Studies thesis Lieutenant Colonel J. Taylor Sink argued for partial decentralization of air power operations.

> [He concluded that] limited decentralization is probably most appropriate for conventional war, since many efforts are being conducted simultaneously and some mistakes can be tolerated. Decentralization is not appropriate for raids and demonstrations of force, where specific political result is vital and mistakes not tolerable.[32]

Although the discussion was specifically addressing the merits of decentralized control of airpower operations, rather than the implications of centralized execution, Lt Col Sink's conclusion highlights two vital points. First, conventional wars, such as the Gulf Conflict, share factors such as wide scope of operations with multiple, continuous operations, redundant or complimentary attack plans, and a high operations tempo. Complimentary forces conducting a variety of operations tend to avoid the potential for single point failure based on the success or failure of a single mission.[33] Therefore, conventional wars may allow more tactical errors and will almost certainly involve more of what Clausewitz called "friction in war" due to the large number of simultaneous operations.[34] Therefore, it is not so much that mistakes are tolerable, but that direct control of a single mission, or a small number of missions, would certainly add significant burdens to the command element, and potentially violate an effective of span of control.

The potential to task overload the AOC is real. Lessons from the Falklands conflict noted that "systems capacity was outgrowing the staff's ability to use the information passed."[35] While the Falklands conflict was a relatively unique scenario, with

British command and control systems and staff structure, the point that a staff could be task saturated is valid. Similarly, an Air Force Institute of Technology study on command management in future, high-tempo, high-technology conflicts noted the type of information required and the processing structure and procedures will depend on the situation. The study also noted that more information could be counterproductive due to shear volume.[36]

Secondly, Lt Col Sink concluded that raids and demonstrations of force should be centrally controlled. Here, the term central control does not necessarily correlate to the Air Force doctrinal term. Rather, Lt Col Sink appears to be using a more broad interpretation of centralized control which, for the purpose of this paper, includes some degree of centralized execution. Therefore, given that a limited-scope raid has the communications and staff structure to support direct control, or centralized execution, of critical missions, centralized execution of some, or all, missions in a high-visibility raid does not necessarily violate an effective span of control. However, centralized execution still conflicts with Air Force basic doctrine.

Unlike conventional wars, raids and relatively small-scale operations, such as the raid on Libya, may rely on the positive outcome of one or more specific missions in order to ensure both military and political success. Further, the potential for near single-point failure, along with a fewer total ongoing operations, may support additional monitoring and control of specific missions.[37] Therefore, when a specific mission has extremely high political visibility, and national prestige is at stake, more direct control of individual assets may be desirable.

In discussing raids, Lieutenant Colonel Robert J. Blunden argued that "because of the political sensitivity of the mission, the NCA, through the Joint Chiefs of Staff, may directly monitor tactical operations."[38] As discussed earlier, monitoring offers the NCA the ability to make political decisions based on real-time information. Similarly, monitoring could allow virtually any level in the chain of command to exercise what can be considered direct control over the mission. While lessons from Iran, Libya, and Grenada would suggest direct control, or centralized execution, is inappropriate, one cannot hope to foresee all future scenarios. Video datalink offers a capability to respond to unique political and military situations with effective direct control.

Gunships were heavily relied upon in a variety of small-scale operations from the Urgent Fury to Operation Uphold Democracy, the planned invasion of Haiti. It is, therefore, conceivable that an AC-130 could be involved in a mission where national prestige rests on the success of a single engagement. Additionally, the capability offered by VDL could allow a gunship to observe a target and provide the NCA with both real-time intelligence and the ability to direct a surgical attack on a desired target. Potentially, the NCA, or designated authority, could use the gunship to achieve a desired political objective with minimal loss of life and damage to property. For example, with a gunship overhead, the controlling authority could offer an adversary a political option rather than face attack. The gunship crew could be directed to attack a specific point as a show of force. As discussed above, video datalink could make this type of operation possible. An obvious caveat is that there must be a permissive environment for the gunship to operate

in without excessive threat to the crew. The trade off between crew autonomy and political requirements must be considered.

Arguing that political considerations make centralized execution appropriate, Joseph F. Bouchard stated that "studies of international crises have repeatedly concluded that the success of crisis management is critically dependent upon top-level political authorities maintaining close control of the actions of their military forces."[39] In *Command in Crisis*, a study on the use of military force as a political instrument during international crisis, Bouchard examined four cases where the US Navy was used to send a political message to a foreign power. Based on the assumption that "close control" was necessary to avoid the possibility of a tactical commander acting counter to national political goals, Bouchard favors a unified pattern of crisis military interaction.

> In this pattern, political-level leaders exercise direct control over tactical-level military operations. Unified interaction is the optimum pattern of crisis military interaction for crisis management. It is the pattern achieved when national leaders succeed in meeting the crisis management requirement that they maintain close control over military operations. If escalation occurs, it is controlled by national leaders, rather than arising inadvertently at the tactical level.[40]

This condition could be described as frictionless, and perhaps Utopian, since every aspect of command and control must function perfectly in order to achieve unified interaction. Bouchard noted that "there were no examples of the unified interaction pattern in the case studies. This suggests that unified interaction is improbable, particularly in a military establishment as large and complex as that of the United States."[41] Other patterns of military interaction described increasing levels of friction. For example,

it is theoretically possible that a tactical commander could make decisions that did not support the national goals.

> Those actions could well be authorized under guidance contained in the mechanisms of indirect control [ROE], but nevertheless complicate political and diplomatic efforts to resolve the crisis. This does not mean that the on-scene commander was wrong to take the actions. For example, he may have been compelled to use force in self-defense as authorized in his rules of engagement.[42]

Paradoxically, the four case studies showed the same frictional factors identified after the Iranian rescue effort, the Libyan raid, and the Grenada invasion. The frictional factors causing a disconnect between political-level leaders and tactical commanders included "communications problems, decisionmaking overload or a fast-paced tactical environment."[43] Bouchard noted that advances in communications technologies have not kept up with the ever-increasing pace of tactical operations. Additionally, he found that the ability of political-level leaders to maintain direct control over tactical-level forces depended upon the size and tempo of the operation, as well as the reliability of the communications technology involved. Finally, Bouchard pointed out that political and military leaders could have different perceptions of the situation based on differing priorities and communications capabilities.[44] The study concluded that clearly defined ROE were a critical factor in avoiding unintentional discontinuity between political goals and tactical requirements. Additionally, Bouchard concluded that tactical-level commanders normally will not dangerously escalate a situation without deliberate guidance form a political leader. The political leader's "deliberate decision could well be based on misperceptions of the adversary's intentions--misperceptions influenced by

inadvertent tactical-level escalation--but the decision for war is still a deliberate decision made by national leaders."[45]

One could argue that Bouchard's conclusion contradicts the assertion that "the success of crisis management is critically dependent upon top-level political authorities maintaining close control of the actions of their military forces."[46] The frictional factors identified in *Command and Crisis* that make optimum-political control of tactical-military operations unlikely are some of the same factors used by the military to support decentralization and delegation of authority to the lowest possible level. Discontinuity between political objectives and military priorities occurred when political leaders attempted to centralize decisionmaking without fully understanding the tactical situation. Therefore, informing a tactical commander of the political intent could avoid dangerous, ill-informed decisions by a political leader.

Bouchard's study managed to identify the friction common to military operations. However, his support of direct-political control of tactical-military operations seems contraindicated, based on his conclusion that the key to successfully obtaining political goals is the concept of issuing the commander's intent and clear, effective ROE. The traditional military solution to friction is to delegate authority to the lowest possible level and issue clear guidance while encouraging a subordinate commander's initiative. In Air Force doctrinal terms, the solution to friction is "decentralized execution," the antithesis of direct-political control of tactical-military operations.

Leadership

The human element of leadership as it relates to the equivocal area between centralized command and decentralized execution is the next major category of implications of VDL on the AC-130. The art of command is very dependent on situations and individual personalities. As noted earlier, it would be impossible to anticipate every combination or permutation of factors that ultimately contribute to a commander's decision on how much positive control is appropriate. However, the potential for more direct control of gunship operations using VDL demands an investigation of the leadership issues associated with direct control.

According to Situational Leadership Theory there are different maturity levels and associated leadership styles for each level. The four levels combine motivation and competence of the individuals being led. Low-follower maturity describes those individuals who lack both motivation to accomplish a task and the competence to perform well. Low-follower maturity requires a very directive leadership style.[47] The US Marine Corps Doctrinal Publication 6 (MCDP 6), *Command and Control*, describes the same concept as authoritarian leadership theory.

> The authoritarian theory of leadership is based on the assumption that people naturally dislike work and will try to avoid it where possible, and that they must therefore be forced by coercion and threat of punishment to work toward the common goal. This theory further argues that people actually prefer to be directed and try to avoid responsibility. The result is an autocratic style of leadership aimed at achieving immediate and unquestioning obedience. Leaders announce their decisions and expect subordinates to execute them. The authoritarian leader is sometimes also known as a "telling" or "directing" leader.[48]

High-follower maturity, on the other end of the spectrum, describes those individuals or groups with both high motivation and ability.

> The leadership style with the highest probability of success in this situation would be low relationship/low task behavior; that is, leaders working with people at this maturity level demonstrate their confidence and trust in them by providing opportunities for them to "run their own show." This is sometimes called the "delegating" style.[49]

The Marine Corps similarly describes this concept as persuasive or delegating leadership.[50]

Just how situational leadership relates to command and control of gunships may best be described by the Marine Corps. The discussion on leadership theory notes; "while authoritarian leadership may result in rapid obedience, it also can often result in subordinates who are highly dependent on the leader, require continuous supervision, and lack initiative."[51] Similarly, Major Thomas H. Buchanan points out that increasingly capable communications technology will give commanders more access to actions at lower levels.

> As a result, the ACC and other high-level commanders will face the temptation to "micromanage" the activities and responsibilities of commanders at lower levels. This "micromanagement" will force low-level commanders to "seek guidance," some of which may be time critical, in order to "cover their butts."[52]

Similarly, in *Command in War*, Martin Van Creveld described how the advance of communications technology increased the tendency of commanders to look to the rear for guidance, rather than concentrating on actions at hand.[53] A command and control arrangement that causes subordinates to rely heavily on the commander has at least two potential hazards. First, a leadership style that fails to encourage initiative may limit the subordinate's effectiveness and damage moral.[54] Second, habitual relationships that cause

aircraft commanders to turn to the AOC for guidance can cause undue burden on the ACC and his staff. Also, and perhaps most critically, aircraft commanders may not develop the judgement and initiative to deal with dynamic conditions in the absence of guidance. In time-critical situations looking to higher authority for guidance could introduce excessive delays. As noted earlier, delays may increase the risk to a crew in a hostile environment and may deny surface forces required fire support. Additionally, increased reliance on sophisticated communications technology may erode both commander's and crews' ability to function if those systems become damaged or degraded. Both of these concerns were identified in a review of the US Army's Task Force XXI Advanced Warfighting Experiment.

> [Information provided by advanced communications technology] could make it possible for a higher commander to centralize decisions, crushing subordinate leader initiative with micro-management. There is also a danger that commanders and leaders at all levels could grow too dependent on "perfect" information and hesitate to seize initiative in the absence of a complete picture. If leaders are conditioned to rely on a "perfect" picture, what happens if the system fails?[55]

A leadership style and command relationship that encourages initiative and the development of judgement is necessary to maximize the capability of a gunship crew.

> The persuasive theory argues that people will exercise initiative and self-control to the degree they are committed to the organizational objective. Under proper conditions, people learn not only to accept responsibility but to actively seek it. According to this theory, the potential for exercising imagination, ingenuity, and creativity in the solution of unit problems is widespread throughout any unit. Leadership thus becomes a question of inspiring, guiding, and supporting committed subordinates and encouraging them to perform freely within set limits. Over time, delegating or persuasive leadership tends to produce subordinates who exhibit a high degree of independence, self-discipline, and initiative.[56]

> Beyond its tactical utility, initiative has an important psychological effect on the members of an organization. Recognizing what needs to be done and taking the action necessary to succeed is a satisfying experience and a powerful stimulant to

> human endeavor. People not merely carrying out orders but acting on their own initiative feel a greater responsibility for the outcome and will naturally act with greater vigor. Thus, initiative distributed throughout is a source of great strength and energy for any organization, especially in times of crisis.[57]

The US military relies heavily on the initiative of low-level leaders and emphasize nurturing and developing initiative. Trust and confidence between both commanders and subordinates is essential to fully develop initiative at all levels. Decentralizing control by delegating authority is seen as a key to developing this trust. Lieutenant Colonel Price T. Bingham, writing on aerospace doctrine, noted the following.

> Delegating authority to subordinates gives them a significant degree of flexibility to act promptly, because they are not delayed by the time it takes to communicate with a higher echelon or the time it takes a higher echelon to make a decision and provide directions.
>
> Delegating authority also has an intangible benefit because it demonstrates a commander's confidence in his subordinates. This can be an important factor in achieving high morale, as it allows those individuals most acquainted with the details of a particular situation to make the decision. Also, knowing he is responsible for a decision often increases a subordinate's initiative and determination.[58]

The influence of trust between commanders and subordinates is critical to gunship operations. The aircraft commander is tasked to lead a crew of five officers and between eight and ten enlisted crewmembers. Crew coordination is very complex as direct access to information is divided between the various crewmembers. It is therefore very important that the crewmembers trust each other and allow individuals to perform specific tasks. For example, the fire control officer coordinates with the two visual-sensor operators and the navigator to search for and identify an assigned target. The aircraft commander must maintain situational awareness by relying on other crewmembers to feed him critical

information. As aircraft commander, the pilot also has to ensure the crew does not become fixated on a particular target or individual task. Maintaining an appropriate tempo with regard to the hazard of the threat environment, situation on the surface, status of the aircraft, and overall mission is essential. It is equally essential that the crew trusts the aircraft commander and his authority to act in a given situation.

Leadership theory dictates that delegating authority to the lowest level must be the rule in order to develop trust between command echelons and to develop initiative and judgement with aircraft commanders. However, there is still the potential for direct control to be effective in unique circumstances. As these circumstances would be the exception to the rule, these contingencies should be carefully developed and practiced.

Lieutenant Colonel Bingham's belief in the importance of delegating authority to those in the best position to have all of the details of a particular situation is noteworthy. In the case of gunship operations, properly identifying a given target involves complex coordination between individual crewmembers. Since different individual crewmembers on the aircraft have direct access to particular pieces of information, extensive crew coordination is required in order to ensure that sensors are looking at the correct target. The types of information include cross referencing continuously moving infrared and television imagery and aircraft position in space, based on the pilot's outside references and a filtered navigation solution that includes global positioning system data. All information is checked against studied target imagery and rules of engagement. Developing this "picture" of the target environment is a complex exercise in crew coordination. Therefore, if a higher level commander attempts to use a segment of video

data sent by the crew, that commander and his staff will only have a fraction of the information available to the gunship crew. This situation is analogous to Bouchard's findings that political leaders were likely to make ill-informed decisions due to a limited understanding of the tactical situation.[59]

In analyzing the implications of VDL on the command and control of the AC-130 gunship this chapter first developed the potential capabilities from the gunship crew's perspective. From a crew perspective, the implications of VDL are fairly strait forward. The addition of VDL portends an increased capability to maintain situational awareness by allowing updated intelligence into the aircraft. Along with improved situational awareness, thereby increasing flexibility and responsiveness, VDL offers the collateral benefit of increased survivability. Potential limitations to these increased capabilities include the potential for task overload, which could decrease situational awareness and, therefore, survivability. However, the potential increase in capabilities derived from VDL could be quite beneficial for gunship operations.

The development of capabilities from the perspective of the ACC showed similar increases in capability. These capabilities included dramatically increased flexibility and situational awareness. An addition to current capability was the potential for gunships to act as real-time reconnaissance assets. The potential for the reconnaissance mission to be seen as mission creep was also demonstrated. Finally, the most significant implication of VDL on gunship operations came in the increased potential for the ACC to directly control gunship operations. As discussed in chapter one, direct control can be considered a form of centralized execution. As the master tenet of Air Force doctrine is centralized

control and decentralized execution, the potentially increased capability to directly control gunship operations conflicts with current doctrine. Therefore, the implications of increased control capability were explored in detail. First, the doctrinal conflict was investigated to show some ambiguity about exactly what constitutes decentralized execution. As current Air Force doctrine does not clearly identify the threshold between centralized control and decentralized execution, the implications of direct control of tactical assets by higher-level commanders was explored. This portion of the chapter looked at relevant historical lessons and found that after-action reviews identified direct control of tactical missions as problematic. Additional implications of direct control by higher level commanders was discussed from a political and military standpoint. This portion of the analysis revealed a broad, theoretical concern for direct control of tactical missions. Finally, the human element of direct control was evaluated to identify any conventional wisdom about leadership vis-à-vis direct control of tactical operations. There was significant support for decentralized execution, or non-direct control, based on leadership theory and military leadership doctrine.

Chapter five attempts to draw some conclusions about the potential benefits and hazards of the implications of VDL described in this chapter. In particular, conclusions and recommendations are made about the potential for direct control of gunship operations using the increased capability of video datalink.

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[58] Lt Col Price T. Bingham, *Battlefield Air Interdiction and the Evolution of Doctrine* (Maxwell AFB, AL: Air University Center for Aerospace Doctrine, Research, and Education), 9-10.

[59] Bouchard 211-218.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

> Delegation of execution authority to responsible and capable lower-level commanders is essential to achieve effective span of control and to foster initiative, situational responsiveness, and tactical flexibility.[1]
>
> Air Force Basic Doctrine

Chapter four identified a number of additional capabilities available to both gunship crews and command and control elements with the installation of video datalink (VDL) on the AC-130. The capability for commanders to monitor crew activities provides an increased capability for distant commanders to exercise direct control of gunship operations. This additional control capability led to a number of command and control implications. The investigation of doctrinal and historical references, as well as fundamental leadership principles, showed that increased capability to direct tactical missions from distant locations may allow a command and control relationship that violates the Air Force doctrine of decentralized execution. Moreover, the weight of the evidence suggests that an air component commander (ACC) must exercise restraint with the additional control capability offered by VDL. Still the appropriate level of direct control for every situation was not specifically illustrated by the research. Therefore, the first part of this chapter develops some general conclusions about additional capabilities offered by VDL. Based on those conclusions, the second part of this chapter suggests some specific recommendations for command and control relationships, rules of engagement (ROEs), training, and finally, system capabilities and their implications.

Conclusions

In general, the implications for sending video images to gunships are very positive. There is enormous potential for improving the crew's situational awareness and survivability by allowing inflight updates to supplement mission planning. Additionally, VDL sent from surface controllers could enhance close air-support control procedures, thereby allowing more timely and accurate delivery of firepower. Video data sent to gunships could facilitate inflight tasking by allowing the crew to perform inflight mission planning and rehearsal and, therefore, increase a commander's flexibility at both the theater and at the national level. As pointed out in Air Force and Navy demonstrations, the capability for inflight tasking could be most beneficial in rapidly changing situations or when the opportunity to attack a mobile target is very brief. The potential for task saturation of the crew is the only apparent negative implication associated with transmitting data to the gunship. Recommendations for training and system capabilities will address this consideration.

On the other hand, the implications of gunships transmitting video imagery to a command and control agency, such as the air operations center (AOC) are somewhat problematic. Chapter four showed that gunship sensor imagery, transmitted to the AOC, could provide command echelons an expanded reconnaissance capability. Similarly, battle damage assessment, sent from the gunship to the AOC, can increase the air component commander's (ACC) situational awareness. Ultimately, the increased communications capability, provided by VDL, combined with the video-based targeting of the AC-130, gives any level of command authority an increased ability to exercise direct control of

gunship operations. Both the potential to use the AC-130 as a reconnaissance platform and the increased control capability present some concerns.

Reconnaissance

Video datalink could make the AC-130 a convenient and capable reconnaissance platform, but there are some factors to consider. Operations tempo has been very high in the AC-130 community. Tasking gunships for reconnaissance missions will reduce the number available for more traditional gunship missions, such as close air support and interdiction. Reflecting this concern, a 1997 Congressionally mandated study on the requirements for gunships showed that current operations tempo deny training opportunities for both gunship crews and the surface forces gunships may support.[2] Additionally, the AC-130 is not an unmanned aerial vehicle (UAV). With a crew of thirteen to fifteen, no ejection seats, large size, and limited speed and maneuverability, any potential threat to the aircraft must be weighed against the value added by the reconnaissance capability. There are likely to be times when the risk of loosing an aircraft outweighs the value added by the capability, but there will probably be times when the requirement for intelligence is so great, or the threat to the aircraft is so low, that the ACC will elect to exploit the extensive sensor capability of the gunship.

Increased Control Capability

Perhaps the most problematic of the additional capabilities offered by VDL installation on the AC-130 gunship is the increased direct-control capability. Lessons from Operation Eldorado Canyon suggest increased communications capabilities should be used to allow senior level commanders the flexibility to make adjustments to ongoing

operations. Additionally, the capability of VDL, particularly associated with the sensor-based targeting of the AC-130, provides the means for commanders, at virtually any level, to become "virtual crewmembers" or to exercise what could be considered centralized execution of gunship operations. Centralized execution, or direct control, of tactical decisions that are normally the purview of the aircraft commander present a variety of concerns about the effective span of control, fostering of subordinate-leader initiative, and tactical flexibility. Unfortunately, the multitude of variables associated with command and control makes identifying an indisputably correct level of direct control for any specific mission virtually impossible. As pointed out in chapter four, it would be impossible to anticipate every combination and permutation of political and military events that could influence a commander to exercise more- or less-direct control over gunship operations. Also, the personality and capacity of the higher-level commander will ultimately influence the level of direct control. Therefore, the second portion of chapter four considered the implications of the increased capability for commanders to exercise direct control of tactical missions. The sources were doctrinal references, lessons from recent operations, and leadership theory. From this research some conclusions about the overall implications of centralized execution can be drawn.

An overarching conclusion from the research is that basic Air Force doctrine leaves room for interpretation and flexibility between the type of command and control arrangement that constitutes centralized control while still supporting decentralized execution. Additionally, the inherent flexibility of air power suggests that command and control arrangements *should* change to adapt to specific circumstances. Therefore, any

effort to define the exact command and control relationship to achieve the optimum balance between centralized control and decentralized execution for every contingency would, ultimately, violate the tenet of flexibility.[3]

However, some meaningful conclusions can be drawn from a cost-versus-benefit analysis of the research. First, the cost of overcentralization can be related to the discussion of centralized control and decentralized execution found in *Air Force Basic Doctrine* which states the following.

> Delegation of execution authority to responsible and capable lower-level commanders is essential to achieve effective span of control and to foster initiative, situational responsiveness, and tactical flexibility.[4]

Span of Control

Therefore, one can conclude that any command and control arrangement that interferes with the "effective span of control" is a cost to operational efficiency. More specifically, any arrangement that interferes with the effective span of control directly conflicts with the supporting argument for decentralized execution.[5] In chapter four, lessons from the Falklands and an Air Force Institute of Technology study pointed to the potential for information overload at the AOC, and higher echelons, due to the volume of electronic information available. If the ACC or his staff becomes task saturated in an effort to exercise direct control of gunship missions, the level of direct control violates effective span of control and should be considered excessive.

Survivability and Tactical Flexibility

Similarly, if decisions about tactical employment are significantly delayed due to the volume of information available at the AOC, the level of direct control could interfere

with tactical flexibility and degrade survivability and, therefore, should be considered excessive. The critical consideration vis-à-vis delays in making or issuing decisions is when those delays becomes excessive. The acceptability of delays will primarily depend on three factors. First, the threat to the gunship must be considered. As noted in chapter four, delays increase exposure to hostile threats. Since a primary concept for gunship survival is to "limit exposure," delays caused by the use of VDL conflict with the principle of achieving tactical flexibility and degrade aircraft survivability.[6] However, if there is little or no threat to the aircraft, delays may be acceptable vis-à-vis survivability. Second, the time available to accomplish a given mission must be considered. If a gunship is asked to provide close air support for surface forces under fire, any delays in issuing clearance to fire from the AOC may endanger friendly forces and their mission. Similarly, delays in clearance to fire may allow a mobile target to escape. Therefore, even if delays do not directly endanger the gunship, those delays may deny tactical flexibility. The third factor is the political sensitivity of a particular mission. Drawing from School of Advanced Airpower Studies, Air Force research projects, and a study on the use of the military as a political instrument during international crisis, chapter four showed that, during a politically-sensitive contingency, commanders from the ACC to the NCA could potentially issue rules of engagement (ROE) that retain, at a senior command level, the authority to make tactical decisions. Tactical decisions, based on interpretation of video supplied by the aircraft observing the target, are normally the purview of the on-scene commander. Therefore, retaining execution authority at a senior command level inherently limits

"situational responsiveness and tactical flexibility." However, the cost of delays in survivability of the crew and tactical flexibility must be weighed against the political benefits of this level of direct control.

Political Sensitivity Versus Threat

The first consistent theme throughout the literature was that delegating execution authority to competent subordinate leaders is the best way to avoid ill informed decisions or miscommunications. The second consistent theme throughout the research, which conflicts with the first theme, was that as the political sensitivity of an operation increases, so will the tendency for a more direct-control relationship between the ACC and a gunship crew. On the other hand, as the threat to the gunship increases, the greater the requirement for a more indirect-control relationship. Therefore, a highly politically-sensitive mission may allow a direct-control relationship if the threat to the gunship is very low. In this case, the conflict between fundamental leadership principles and direct-control relationship must be understood and acceptable to the ACC. In the case of a significant threat environment, delays associated with direct control degrade gunship survivability. Therefore, even if the political sensitivity is high, a direct-control relationship is contraindicated in a significant-threat environment, unless losing a gunship is acceptable.

Initiative

While a command and control relationship that exceeds an effective span of control, degrades survivability, or limits tactical flexibility may have immediate effects and, therefore, be easily recognized, a relationship that fails to foster initiative in subordinate

commanders may have more delayed effects and, therefore, be more difficult to recognize. Military leadership doctrine, studies of leadership in war, academic works on management, and a review of the Army's Advanced Warfighting Experiment revealed several implications of command relationships that are overly directive in nature. The long-term effects of overly-directive command relationships are subordinates who lack initiative and require extensive supervision. Additionally, the lack of trust demonstrated by overly-directive control damages morale and undermines a subordinate commander's authority. These effects may take time to manifest themselves and, therefore, may not be readily apparent to the senior level commander. It is therefore critical that commanders understand the long-term implications of overly-directive command relationships. For example, requiring the aircraft commander to obtain additional guidance from a controlling agency could undermine his authority and further complicate a complex leadership challenge.

However, even if the ACC is aware of the potential effects of a highly-directive command relationship, he may still elect to exercise direct control over gunship operations. This possibility suggests that certain circumstances dictate violating basic Air Force doctrine of decentralized execution. As previously discussed, missions with extremely-high political visibility may drive a more direct-control relationship.

Recommendations

Having identified some conclusions about the implications of VDL on the AC-130, some basic recommendations may help to mitigate any potential difficulties.

Reconnaissance

Before tasking the AC-130 for a reconnaissance mission, the tasking authority should deliberately consider the trade-off between the risk to the crew and the value of the reconnaissance capability. Then, if gunships are to be used as reconnaissance platforms, the tasking authority should make this additional tasking very clear, with the understanding that, over a period of time, the skills needed for more traditional gunship missions may deteriorate. This deterioration should be considered an additional cost associated with using gunships in a reconnaissance role. While the cost may be acceptable, it should be considered and acknowledged by the tasking agency. Further, crews should be given the opportunity to train specifically for reconnaissance missions in order to fully develop any additional skills required.

Politically Sensitive Operations

Based on the theme that delegating execution authority to competent subordinate leaders is the best way to avoid ill informed decisions or miscommunications, it seems reasonable that commanders at all levels should consider the lessons of history, and, in so doing, exercise restraint, and delegate tactical authority to the on-scene commander. In most cases, the ACC should develop ROE that fully express his intent, but allow the aircraft commander, as the on-scene commander, to make final decisions. If political constraints require a highly-directive command relationship, the ACC should fully explain the reasons for exercising direct control. By explaining the situation, the ACC could mitigate some of the potential damage to morale caused by an apparent lack of trust in his subordinate

commanders. Further, if crews are aware of the context of the direct-control measures, they will be better able to adapt to a given situation and maintain tactical flexibility.

Also, it is conceivable that an ACC could require his staff to identify or verify a target prior to granting clearance to fire. For those situations, or anytime the ACC elects to use gunship video as a decision making tool, the AOC staff must include qualified and experienced gunship-video interpreters, preferably qualified sensor operators. Otherwise the ACC risks making decisions with less information and expertise than that of the on-scene commander. Lessons learned from a variety of contingencies showed the hazard of high-level commanders making decisions with limited and incomplete information.

Training

Developing the skill to maintain situational awareness during complex missions takes years of training and hundreds of flight hours. Habits learned during training are ultimately repeated during combat. Therefore, it is essential that relationships between crews and a controlling agency must be clear and exercised so as to become routine if that relationship is expected to be effective in combat. Additionally, since competent subordinate commanders are critical to the successful delegation of authority, the development and selection of these commanders should be emphasized. Potentially, if the senior leadership has more faith and trust in his subordinate's abilities and judgement, he will be more likely to delegate authority. Therefore, training and education programs should be reviewed and modified to emphasize not only technical competence, but the development and selection of capable subordinate leadership.

System Capabilities

The final portion of the this chapter are some recommendations about system capability and limitations. If a video datalink is to be added to the AC-130, it should be a system that adds capability while not overly increasing the already substantial workload or constituting a significant distraction for the crew. Also, any system added should avoid reducing any existing capability. Finally, the technical protocol should be compatible with as many national systems as possible.

Any video datalink system should be "user friendly"; i.e., the system should not only be easy to operate, but should be fully integrated into the existing architecture of the AC-130. Hardware should not be just an add-on rack of electronic equipment that requires a crewmember to move from a normal duty position in order to operate the system. Such an arrangement could take a crewmember from a normal position and, thereby, reduce the overall crew efficiency. Similarly, if the controls are not easily accessible, one can expect delays in operating either the VDL system or other gunship equipment. As noted previously, any delays in tactical operations could add significant risk to the aircraft, crew, and mission. Fully integrating a new electronic system may be more expensive than other alternatives, but integrated systems will yield more value to the mission than systems that are either difficult or distracting to operate. Further, the author's experience has shown that equipment that is difficult to operate will not be fully exploited, particularly during stressful periods such as actual combat.

Integrating a VDL system onto either the AC-130H or AC-130U will require extensive coordination with the crewmembers that operate sensors and fire-control

equipment. Also, because both aircraft are significantly different in internal layout and technical capability, it may not be practical to develop a gunship-common installation. However, since both aircraft have nearly the same capabilities, any VDL system capabilities should be identical, or nearly so.

If, due to budgetary constraints or technical limitations, fully integrated VDL systems are not possible then temporary systems may be installed. However, the limitations of these temporary systems should be fully understood by crews and command elements. Potential limitations may include the capability to transmit only single-frame video. Single-frame video may be useful for BDA assessment or very specific reconnaissance requirements, but would significantly degrade the amount of detail a crew could transmit to a controlling agency. As pointed out in chapter one, the crews use the continuous images from separate sensors run by qualified operators, along with many other factors, to develop situational awareness. Therefore, if an AOC staff only has access to single-frame video transmissions, that staff will have only a fraction of the situational awareness tools available to the gunship crew. This lack of situational awareness at the AOC suggests that an AOC staff would not be in a position to verify or dispute a crew's opinion about the validity of a particular target. Therefore, without an adequate amount of information available, it appears inappropriate for an ACC or his staff to maintain rules of engagement that require verification of a target via VDL to the AOC. In order to avoid confusion, the definition of adequate amount of information should be clarified prior to any actual use of limited VDL capability to remotely verify targets.

Another potential limitation of VDL systems is data-transfer rate. Systems that take several minutes to transfer a single frame of video will have limited utility due to inherent delays. Therefore, a near-real-time system, unless the delay is very short, should be considered a major limitation . Near-real-time systems could be useful if delays can be accepted, such as in a very low-threat environment when mission timing was not critical. These systems could also be useful for sending a crew updated video while enroute to a target. However, if delays are unacceptable, such as in a significant-threat environment, near-real time systems may be more of a hazard than a value added.

The third potential category of limitation is image quality. If gunship imagery is degraded by transfer technology, the ACC must be aware that the crew will be in a much better position to interpret imagery than the AOC staff. Conversely, if images sent to the gunship are degraded, those images may still be better for target updates than no image at all. Another major consideration is the radio used for data transfer. Gunships normally operate with beyond line-of-sight satellite communications (SATCOM) for command and control. Therefore, a SATCOM radio should be used for VDL. However, the VDL should not use the existing SATCOM radio if data transfer would interfere with voice capability. As pointed out in chapter four, voice communications is often critical for command and control. If a temporary VDL system interferes with the existing SATCOM radio, that system should be considered extremely limited. Finally, since some of the best imagery available is classified, a VDL system should be secure capable.

The bottom line about capabilities is you get what you pay for. Although temporary systems offer more immediate capability, the inherent limitations, and the

hazards associated with these limitations, make temporary systems less desirable. In any case, exercises and training will more fully develop both capabilities and limitations of any system. Therefore, individual initiative and experience will go a long way in making the integration of VDL on the AC-130 a benefit to both crews and commanders.

Summary

Finally, conclusions about the potential for VDL to make the AC-130 a better reconnaissance platform suggests that any additional capabilities should be considered from a holistic approach vis-à-vis the burdens and hazards of exploiting technology. Moreover, the potential for dramatically increased direct control of gunship operations offered by the integration of VDL is problematic. Direct control by higher-level commanders can be considered a form of centralized execution. In some cases this conflict with Air Force doctrine can directly violate the intent of decentralized execution by violating the effective span of control of the ACC, or by stifling initiative of subordinate commanders and crews. Considering these costs of centralized execution, an ACC may still be tempted to violate Air Force doctrine in an effort to ensure sensitive political goals are met. However, the lessons that produced the tenet of centralized control and decentralized execution appear to have rejected the requirement for centralized execution, even in politically sensitive, high visibility missions. Therefore, it is, as historical lessons have repeatedly demonstrated, incumbent on the senior leadership to select carefully subordinate commanders, to develop and maintain trust within the command structure, and to exercise restraint in order to achieve optimal performance from tactical commanders.

While this was limited to a study of the implications of VDL on the command and control of gunship operations, the concepts developed in this paper may apply equally well to other weapon systems. Additionally, the potential to exercise direct control of tactical operations of airpower assets illuminates the broader issue of the increasing potential for emergent technologies to allow senior commanders to exercise direct control of tactical operations of almost any level. Therefore, this work should be a point of departure for a broader and more exhaustive study into the implications of emergent technology on the command-and-control relationship between commanders at all levels, including political leadership. An expanded study should attempt to identify both the long-term costs, including inherent risks, and short-term benefits of the increasing capability to exercise direct control of tactical operations. Additionally, further study may identify general categories of factors that could make centralized execution more beneficial than costly. Conversely, those factors that make centralized execution more costly than beneficial should be found. From this cost-benefit analysis some conclusions may offer guidance to future senior commanders vis-à-vis the development and potential modification of US doctrine. Finally, additional study may expand and clarify the implications of centralized control and decentralized execution of airpower assets.

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[1] Air Force Doctrine Document 1, *Air Force Basic Doctrine*, September 1987, 23.

[2] *AC-130 Gunship Study: Report to Congress for ASD/SOLIC* (Pentagon, Washington DC, April 1997), 43.

[3] *Air Force Basic Doctrine*, 23-24.

[4] Ibid., 23.

[5] Ibid.

[6] Air Force Special Operations Command Instruction 11-202, Volume 10, *AC-130H Operations*, 1 November 1994, 6.

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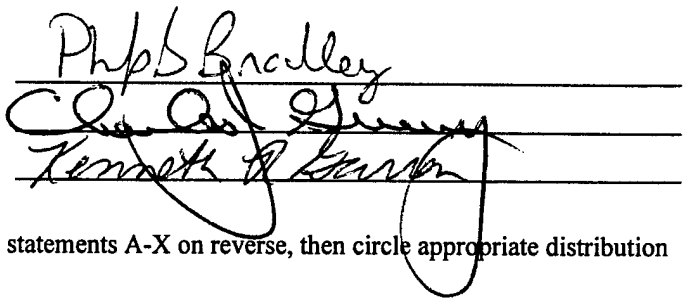

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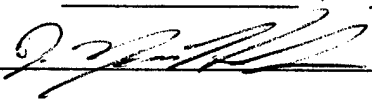
7. MMAS Thesis Author's Signature: 

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